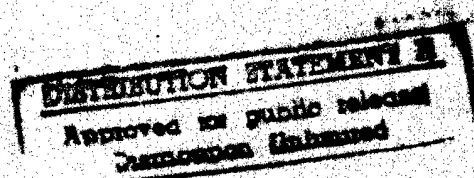




October 1997

# NAVY AVIATION

## V-22 Cost and Capability to Meet Requirements Are Yet to Be Determined



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DTIC QUALITY INSPECTED

National Security and  
International Affairs Division

B-272631

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Congressional Committees

DISTRIBUTION STATEMENT A

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This report conveys the results of our review of the V-22 Osprey program. The program is intended to provide 523 new tilt-rotor aircraft—425 for the Marine Corps, 50 for the Special Operations Command (SOCOM), and 48 for the Navy. Since the program began over 15 years ago, Congress has continued to provide funding, while expressing concern that the planned low rate of production is inefficient. Our objective was to review the status of the program to identify areas of potential cost increases or performance challenges and assess whether the aircraft being developed will meet the stated requirements of each of the services. We are addressing the report to the congressional committees that have jurisdiction over the matters we discuss.

## Background

The V-22 Osprey program was approved in 1982. The V-22 was being developed to meet joint service operational requirements that would satisfy various combat missions, including medium-lift assault for the Marine Corps, search and rescue for the Navy, and special operations for the Air Force. The program advanced into full-scale development in 1986. In December 1989, the Department of Defense (DOD) directed the Navy to terminate all V-22 contracts because, according to DOD, the V-22 was not affordable when compared to helicopter alternatives. DOD notified Congress that in order to satisfy the joint service requirements, the aircraft would require substantial redesign and testing. Congress continued to fund the program and in August 1992, the Acting Secretary of the Navy testified that a V-22 that met the joint service operational requirements could not be built with the funds provided. In October 1992, the Navy terminated the V-22 full-scale development contract and awarded a contract to begin engineering, manufacturing, and development (EMD) of a V-22 variant.

During the FSD phase, five prototype aircraft were built.<sup>1</sup> We have been monitoring the V-22 program for the past several years. Our reports<sup>2</sup>

<sup>1</sup>Two of these prototype aircraft were destroyed in crashes. The cause of the first crash, which occurred in June 1991, was reported to be incorrect wiring in a flight-control system. The cause of the second crash, which occurred in July 1992, was reported to be an on-board fire due to component failures and design problems in the engine nacelles.

<sup>2</sup>Defense Acquisition Programs: Status of Selected Systems (GAO/NSIAD-90-30, Dec. 14, 1989); Naval Aviation: The V-22 Osprey-Progress and Problems (GAO/NSIAD-91-45, Oct. 12, 1990); and Naval Aviation: V-22 Development Schedule Extended, Performance Reduced, and Costs Increased (GAO/NSIAD-94-44, Jan. 13, 1994).

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consistently discussed testing and development issues such as weight, vibration, avionics, flight controls, landing gear, and engine diagnostic deficiencies.

The current V-22 program, which entered EMD in 1992, is scheduled to proceed with developmental testing through 1999. During the EMD phase, the contractor is required to build four production representative aircraft to Marine Corps specifications and deliver them to Patuxent River Naval Air Station, Maryland, in 1997 for developmental and operational testing. Operational testing for the Marine Corps' V-22 is scheduled to extend into fiscal year 2000.

After completion of operational testing to determine whether the EMD aircraft will meet Marine Corps requirements, one of the aircraft will be remanufactured and tested to determine whether it will meet SOCOM requirements. Operational testing for the SOCOM variant is scheduled to extend through fiscal year 2002.

In March 1997, one EMD aircraft was delivered to Patuxent Naval Air Station to begin developmental and operational testing. Three more aircraft are under construction and are expected to be delivered by October 1997. DOD approved the program to begin low-rate initial production (LRIP) in April 1997 and will purchase 25 V-22 aircraft in 4 LRIP lots of 5, 5, 7, and 8 through fiscal year 2000.

Full-rate production is scheduled to begin in fiscal year 2001 and continue through fiscal year 2018. Initial operational capability (IOC)<sup>3</sup> for the V-22 Marine Corps variant is scheduled for 2001 and in 2005 for the SOCOM version. IOC for the Navy V-22 aircraft has not yet been specified.

Through fiscal year 1997, more than \$6.5 billion has been provided for the program.

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## Results in Brief

The V-22 has been in development for almost 15 years. Although Congress has provided significant funding and support to DOD, the system has not yet achieved program stability in terms of cost or aircraft design. There are large disparities among the cost estimates from the program office, the contractors, and the Office of the Secretary of Defense. These estimates range from about \$40 million to \$58 million for each aircraft. The design of

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<sup>3</sup>IOC is the first attainment of the capability to effectively employ 12 aircraft, operated by an adequately trained, equipped, and supported military unit.

the aircraft will not be stabilized until further testing is completed and several important performance and operational issues, such as payload capability, aerial refueling, and downwash<sup>4</sup> are resolved. Resolution of these issues, which could also require mission trade-offs or changes to planned operational concepts, will likely escalate program costs and extend the program schedule. The April 1997 LRIP decision was based, in large part, on the results of early operational testing using aircraft produced under an earlier full-scale development program. However, those aircraft are not representative of the aircraft currently being developed during the engineering and manufacturing development phase of the V-22 program. Furthermore, the DOD Director, Operational Test and Evaluation, has characterized the tests on which the LRIP decision was based as "extremely artificial" because of significant test limitations. Future production decisions for the V-22 should be based on more realistic testing.

## Cost Estimates Vary

The cost data reported in the December 31, 1996, V-22 Selected Acquisition Report (SAR) is different from the data in the program office submission to support the fiscal year 1998-99 President's Budget. For example, the SAR indicates that average unit flyaway costs<sup>5</sup> at program completion would be about \$55.4 million, while the program office estimate for the President's Budget shows that average unit flyaway cost will be about \$57.5 million at program completion. Table 1 provides a comparison of the various cost estimates at different program milestones. (See app. I for a more detailed comparison.)

<sup>4</sup>The downward force from the V-22 proprotor blades while in a hover mode.

<sup>5</sup>We used unit flyaway cost estimates for comparison because they are more standardized and concentrate on those costs directly related to the production of the aircraft. This includes the cost of the basic system equipment, as well as both recurring and nonrecurring costs associated with the production of a usable end item of military hardware.

**Table 1: Comparison of V-22 Cost Estimates at Various Program Milestones (then-year dollars in millions)**

Milestone	Year	Units produced		Program office data		SAR data	
		Annual	Cumulative	Average unit flyaway cost		Average unit flyaway cost	
				Annual	Cumulative	Annual	Cumulative
LRIP begins	1997	5	5	\$116.0	\$116.0	\$112.3	\$112.3
Last year LRIP	2000	8	25	76.4	91.3	73.9	88.5
Full-rate production/SOCOM V-22 begins	2001	16	41	73.7	84.5	71.2	81.8
Production lot 9 <sup>a</sup>	2005	31	158	53.9	65.1	51.8	62.7
Navy V-22 begins	2010	26	299	52.2	59.0	50.2	56.8
Program completion	2018	30	523	59.3	57.5	57.0	55.4

<sup>a</sup>This lot is included because it contains production unit number 153, the point at which the program is expected to reach the contractor estimated unit cost of \$40.9 million.

Furthermore, the contractor is estimating that the average unit flyaway cost, in then-year dollars, for the V-22 will eventually get down to about \$40.9 million. The contractor estimate is based on the assumption that the production quantities and cost will stabilize (commonly referred to as the production learning curve) at about the time that aircraft number 153 is produced. Thus, the contractor estimate of \$40.9 million would occur at a point in time in the program when the program office estimate and the SAR indicate that the average unit flyaway cost would be about \$53.9 million and about \$51.8 million, respectively.

These widely differing estimates indicate that the V-22 has not matured to the point that there can be reasonable confidence that the costs are stable. This is particularly true because, as discussed later, the aircraft design is not yet stable and further changes are expected as the test program continues. Resolution of performance and operational issues will likely increase V-22 program costs. In that regard, we and other organizations, such as the Congressional Budget Office and the Institute for Defense Analyses, have performed reviews of weapon systems over the years that have shown that, historically, the cost of major weapons programs increases by over 20 percent.<sup>6</sup>

<sup>6</sup>Weapons Acquisition: A Rare Opportunity for Lasting Change (GAO/NSIAD-93-15, Dec. 1992); CBO Papers: An Analysis of the Administration's Future Years Defense Program for 1995 Through 1999 (Jan. 1995); and The Effects of Management Initiatives on the Costs and Schedules of Defense Acquisition Programs, Volume I: Main Report (IDA Paper P-2722, Nov. 1992).

## Unresolved Issues May Impact Multi-Mission Requirements

At this point in the V-22 program, it is questionable whether the aircraft being produced will be able to meet the multi-mission requirements outlined in the current Operational Requirements Document (ORD). The following are some issues that must be resolved before a determination can be made as to whether the V-22 will satisfy the services' stated requirements.

## External Payload

The current Marine Corps medium-lift helicopter fleet, consisting of CH-46E and CH-53D helicopters, is aging and now has an average age of 24 to 27 or more years. Navy and Marine Corps documents indicate that this fleet is deficient in payload, range, and speed. In addition, the fleet is incapable of providing the operational performance needed by the Marine Corps. And, according to Marine Corps officials, the medium-lift aircraft inventory is well below what is required.

While the V-22 is to replace the Marine Corps' CH-46E and CH-53D helicopters, its payload capabilities have yet to be demonstrated. The ORD stipulates that the V-22 must be able to lift external loads up to 10,000 pounds. By comparison, the CH-46E and CH-53D are able to lift 8,000 to 12,000 pounds. Testing to evaluate the V-22's lift capability, and to measure structural load/stresses/strains in flight and the operational capabilities to carry external cargo is planned to take place in fiscal year 1998. Moreover, it has yet to be determined if the high-speed capability of the V-22 will enhance the Marine Corps' external lift capabilities, since the airborne behavior of operational equipment such as multi-purpose vehicles, heavy weapons, and cargo vehicles carried at speeds at or in excess of 200 knots has yet to be tested. If the V-22 cannot rapidly move operational equipment, then its utility as an external cargo carrier to replace current Marine Corps medium-lift assets will have to be reevaluated.

## Terrain Following/Terrain Avoidance Capability

The V-22 ORD requires that, at a minimum, the CV-22 have the capability to fly at 300 feet using terrain following/terrain avoidance, in all weather conditions during both daylight and night-time environments. Testing done with the FSD prototype V-22 aircraft has shown that the AN/APQ 174 multi-functional radar, which would provide this capability, interferes with the V-22's radar jamming system. Further EMD aircraft testing with the AN/APQ 174 radar system is necessary to resolve this issue. That testing is not scheduled to be completed until the middle of fiscal year 2001.

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## Refueling Probe

According to the ORD, the V-22 must have an aerial refueling receiver capability compatible with current Marine Corps and SOCOM tanker assets. SOCOM personnel told us that it was vital for both the pilot and the co-pilot to be able to see the probe during aerial refueling. However, the current V-22 design prevents the pilot in the left seat of the aircraft from being able to see the refueling probe. Testing to date with the full-scale development version of the aircraft shows that the pilot in the left seat must either raise the seat or lean forward in the seat to clearly see the refueling probe.

According to SOCOM officials, being able to readily see the refueling probe from both pilot seats without the pilot having to make these physical adjustments is essential to safe flight operations. From a mission and training point of view, these officials claim that it is critical that both pilots be able to see the entire refueling operation in the event that the pilot in the left seat has to take over the operation. While SOCOM pilots perform significantly more missions requiring refueling, Marine Corps officials told us that they believe that as long as the pilot in the right seat can clearly see the probe, the pilot in the left seat could make necessary adjustments to safely conduct the refueling mission should the need arise.

V-22 program officials have agreed that if future testing shows that the current design of the refueling probe is a problem, necessary steps will be taken to correct the baseline aircraft. However, if a redesign is necessary, it could have an impact on aircraft performance (weight, range, and speed) or other aircraft systems, such as the radar.

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## Proprotor Downwash

The downward force from the V-22 proprotor blades while in the hover mode (referred to as downwash) continues to be an area of concern. Downwash is a concern for both the Marine Corps and SOCOM in areas such as personnel insertions/extractions, external load hookups, fast rope exercises, and rope ladder operations.

According to DOD documentation, the extremely intense rotor downwash under the aircraft makes it a challenge to stand under the aircraft, let alone perform useful tasks. According to the DOD Director, Operational Test and Evaluation report issued in March 1997, resolution of this issue will require further testing. Program officials told us that downwash is a common concern with rotary aircraft and V-22 users will have to adjust mission tactics while under the aircraft to compensate for downwash.

## Survivability Trade-Offs

Survivability is a critical concern as the services seek to perform their missions, particularly in hostile environments. The V-22 ORD defines the necessary capabilities that must be available on each configuration of the aircraft. However, our review showed that in order for the aircraft to meet key performance parameters, such as range, trade-offs are being considered. Critical subsystems may be delayed or deleted, while others may require future upgrades or modifications that may affect the program's cost and schedule.

One such subsystem is the AN/AVR-2A laser-warning receiver. By giving the pilot advance warning, this subsystem would reduce the susceptibility of the aircraft to laser illumination and attacks. The ORD requires that consideration be given to protecting crew and electro-optical sensors from low- to medium-powered lasers. While the Marine Corps V-22 aircraft will have this capability, the SOCOM V-22 aircraft will only have space and wiring provisions. Currently, the SOCOM variant will not have the laser-warning receiver because, according to SOCOM officials, it would prevent the aircraft from meeting its range requirements. In that regard, the V-22 ORD states that a key performance parameter for the SOCOM variant is the requirement for a mission radius of 500 nautical miles; that is, the aircraft must have the ability to fly from a base station out to 500 nautical miles, hover for 5 minutes, and return. According to SOCOM officials, the V-22 will not meet this range requirement with the laser-warning subsystem installed. SOCOM officials contend that the lack of the laser warning receiver is a concern relative to successful mission accomplishment and survivability of aircraft and crew.

Another survivability concern is the lack of a defensive weapon on the V-22. The requirement document states that the V-22 must have an air-to-ground and air-to-air weapon system compatible with night vision devices. This is a required capability for the Marine Corps variant and a desired capability for the SOCOM variant. Originally, the V-22 was to be equipped with a 50-caliber machine gun; however, for affordability reasons, it will now be produced without a defensive weapon system.

Finally, the ORD requires that the V-22 include a ground collision avoidance and warning system with voice warning. Currently, the Navy claims that this requirement was added to the ORD after the V-22 had validated its design and, therefore, was not included in the planned production. Instead, the system is a potential limitation to the Marine Corps' V-22 configuration and will be included as a preplanned product improvement to be evaluated through the course of the test program. The Navy intends



to correct this deficiency, most likely through a retrofit process, and pay for it within program baseline funding.

## More Realistic Testing Needed

The V-22 program was approved to proceed with LRIP in April 1997. One of the primary criterion that the program was required to meet was the completion of an operational assessment endorsing potential operational effectiveness and suitability<sup>7</sup> of the V-22's EMD design.<sup>8</sup> Three series of early operational assessments were used to support DOD's LRIP decision. Due to the significant limitations of these early operational assessments, their reliability as the basis for deciding to proceed into LRIP is questionable and future production decisions should be based on more realistic tests.

The three operational assessments that have been conducted used aircraft produced under the earlier full-scale development program. Previously, DOD had determined these aircraft to be incapable of meeting V-22 mission requirements and, at one point, the Secretary of Defense sought to cancel the full-scale development program. V-22 program officials believe that even though the full-scale development aircraft did not meet mission requirements, the lessons learned from having produced them reduced the risk associated with developing the current EMD aircraft.

The first of the three early operational assessments was conducted between May and July 1994; the second assessment between June and October 1995. These assessments were conducted jointly by the Navy's Operational Test and Evaluation and the Air Force's Operational Test and Evaluation Center. In both assessments, the joint test teams concluded that the development aircraft demonstrated the potential to be operationally effective and suitable. Although the third assessment was not completed at the time of the decision to proceed with LRIP, an interim report was prepared for this milestone. This report highlighted limitations and risks remaining from previous assessments and cited additional areas of concern, but still projected that the V-22 will be potentially operationally effective and suitable.

<sup>7</sup>Operational effectiveness is the degree to which a system can accomplish its missions when used as expected. Operational suitability is the degree to which the system can be placed satisfactorily in field use, considering such things as availability, reliability, and safety.

<sup>8</sup>Additional criteria, which were met, were (1) empty weight would not exceed 34,182 pounds, (2) complete ferry to Patuxent River Naval Air Station, and (3) demonstrate airspeed of 220 knots.

In March 1997, DOD's Director for Operational Test and Evaluation issued the Fiscal Year 1996 Annual Report. In that report, the Director, Operational Test and Evaluation, concluded that V-22 testing had concentrated on system integration and flight envelop expansion, but had "not extensively investigated mission applications of tiltrotor technology and potential operational effectiveness and suitability of the EMD V-22." The report also highlighted the following operational test and evaluation limitations relative to the operational assessments of the V-22. The aircraft

- was not cleared to hover over unprepared landing zones,
- could not hook up to or carry any external loads,
- could not carry any passengers, and
- was not cleared to hover over water.

The Director, Operational Test and Evaluation report also stated that the aircraft configuration was not representative of any mission configuration. The Director, Operational Test and Evaluation said this combination of limitations to clearance and configuration results in an "extremely artificial" test environment for early operational test and evaluation. The Director, Operational Test and Evaluation also reported serious concerns regarding the effects of downwash previously mentioned in this report and recommended further evaluation in this area.

The initial flight of the first of four EMD aircraft, originally scheduled for December 1996, was delayed until February 1997. As a result, the required ferry to Patuxent River was delayed until March 1997. The aircraft arrived at the test facility needing several changes before the test program could continue as planned. In order to meet the ferry date and thus obtain approval to proceed with LRIP, component changes and modifications were not completed at the contractor's facility. Instead, they were to be completed at Patuxent River after the required ferry flight. During a visit to the Naval Air Station test facilities in April 1997, we observed the aircraft undergoing modifications by contractor personnel. According to test officials with whom we spoke, the modifications were originally only expected to take about 2 weeks. However, as of June 16, 1997, the modifications were still ongoing, nearly 2 months after they began.

The next major milestone decision for the V-22 is the LRIP lot 2 production decision. That decision is scheduled for early 1998 and will represent DOD's approval to procure the next five V-22 aircraft. The criteria that must be met for LRIP lot 2 approval are:

- delivery of two additional EMD aircraft and
- completion of certain static tests to determine the structural strength of the aircraft.

## Impact of Accelerated Production on Schedule and Testing

Congressional committees have expressed concern that the planned V-22 production schedule (4 LRIP lots of 5, 5, 7, and 8 aircraft with eventual full-rate production of as many as 31 aircraft per year through 2018) is inefficient.<sup>9</sup> (See app. I for complete V-22 program schedule and cost estimates.)

In August 1996, the contractors submitted an unsolicited cost estimate to the Under Secretary of Defense for Acquisition and Technology that suggested that accelerated production rates, combined with a multi-year procurement strategy, could result in savings of nearly 25 percent over the life of the V-22 program. The contractor proposed accelerating the production schedule to a rate of 24 aircraft by fiscal year 1999, instead of the 7 aircraft currently planned in fiscal year 1999. DOD responded that while this strategy had the potential for significant savings, it was inappropriate to consider such an alternative until the aircraft design was more stable. DOD indicated that to do otherwise would unnecessarily increase technical risk to the program. In addition, DOD stated that such an increase in annual procurement quantities would not be affordable within the overall defense budget. Further, the May 1997 Quadrennial Defense Review recommended lowering the number of V-22 aircraft to be procured from 523 to 458 and increasing the planned production rate after the program enters full-rate production. The recommendation retains the limited LRIP rates currently planned by DOD.

According to V-22 program test personnel, accelerating the production schedule and increasing the rate would add risk to the program in the event the test program finds problems that require a significant amount of time and resources to fix, and result in a larger number of aircraft to retrofit or modify. These views are consistent with the conclusions in our February 13, 1997, report that described the effects of increased production during LRIP of 28 weapon systems and the cost and schedule impact to these programs.<sup>10</sup> This report showed that when DOD inappropriately placed priority on funding production of unnecessary

<sup>9</sup>H.R. Rep. No. 104-563, at 48 (1996) and S. Rep. No. 104-267, at 59 (1996) on the National Defense Authorization Act for Fiscal Year 1997.

<sup>10</sup>Weapons Acquisition: Better Use of Limited DOD Acquisition Funding Would Reduce Costs (GAO/NSIAD-97-23, Feb. 13, 1997).

quantities during LRIP, the result was a large number of untested weapons that subsequently had to be modified. Moreover, it points out that because of overall budgetary constraints, decisions to buy unnecessary quantities of unproven systems under LRIP forced DOD to lower the annual full production rates of proven weapons thereby stretching out full-rate production for years and increasing unit production costs by billions of dollars.

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## Conclusions and Recommendations

There is no consensus on the acquisition strategy for acquiring the V-22 Osprey. Congress has been attempting to increase the annual production rates to achieve more efficient production and DOD has been attempting to keep the annual production rates at a more limited quantity. The key to efficient production and the efficient use of the funds Congress has provided for the V-22 is program stability. However, after 15 years of development effort, the V-22 design has not been stabilized. To begin the process of achieving consensus on the acquisition strategy for the V-22, we believe that DOD needs to present Congress with a strategy for overcoming the production inefficiencies that Congress views as present in the current acquisition strategy. As part of that strategy, we believe that DOD needs to introduce more realistic testing into the program to achieve aircraft design stability. Ideally, this testing should be done as early as possible in the program schedule and should be directed at ensuring that the required capabilities of the V-22 are adequately demonstrated before a significant number of aircraft are procured. In that regard, the next scheduled major program milestone is the LRIP lot 2 production decision scheduled for early 1998.

Accordingly, we recommend that the Secretary of Defense provide in the Department's next request for V-22 funds an explanation of how it plans to (1) introduce more realistic testing earlier into the V-22 program schedule and (2) achieve the production efficiencies desired by Congress. An agreement between Congress and DOD in this regard would be a significant step toward reaching consensus on the acquisition strategy for the V-22 program.

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## Agency Comments and Our Evaluation

DOD reviewed and partially concurred with a draft of this report. In its comments, DOD agreed to continually assess and correct operational deficiencies found during V-22 testing. However, DOD did not concur with our recommendation to provide Congress an explanation of how it plans to introduce more realistic testing earlier into the V-22 program schedule

and achieve production efficiencies. DOD stated that it considers test results, production efficiencies, and other factors in developing its budget and does not consider additional explanatory materials necessary. DOD also stated that the Defense Acquisition Board, in April 1997, determined that the V-22 test program was adequate and properly sequenced.

We continue to believe that the V-22 test program and the criteria for proceeding with the low-rate production program should be made more realistic. Given the artificial nature of the prior operational testing that was used to justify LRIP lot 1 production and the fact that earlier tests were conducted using nonproduction representative aircraft developed under the earlier V-22 full-scale development program, we believe that DOD should expand the LRIP lot 2 criteria to introduce more realistic testing into the program, using aircraft produced under the EMD phase of the program. We believe that at a minimum, the limitations of the prior tests, which were disclosed by the Director, Operational Test and Evaluation in its March 1997 report, should be addressed before a decision is made to proceed into the next LRIP lot. This would allow the test program to validate the projected capabilities of the EMD-configured aircraft without injecting unnecessary risk into the program.

DOD also emphasized in its comments on our draft report that the Quadrennial Defense Review (QDR) resulted in an accelerated production profile that addresses many of the production efficiencies desired by Congress. The QDR recommends an overall reduction in aircraft for the Marine Corps, from 425 aircraft to 360 with an increase in the rate of production during the full production phase of the program. The four low-rate production lots of 4, 5, 7, and 8 aircraft planned during the period 1997-2000 are retained. It is during this LRIP phase of the program that we believe more realistic testing is needed and should be included as criteria for procuring the next EMD LRIP lots. Therefore, we believe our position is consistent with the intent of the QDR recommendation, which would not take effect until the full-rate production phase of the V-22 program.

DOD's comments and our evaluation of them are presented in their entirety in appendix II.

## Scope and Methodology

We reviewed the status of the V-22 aircraft development and readiness of the program to proceed into production. We reviewed and analyzed test plans and reports, including the Test and Evaluation Master Plan and results of three V-22 Operational Assessments; cost and budget estimates,

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including the SAR and President's Budget Estimates for fiscal years 1997-99; and other program documentation, including the ORD and the EMD and LRIP contracts. We also obtained information on Marine Corps medium-lift requirements and capabilities of existing assets. In addition, we met with officials in the office of the Secretary of Defense and conducted interviews with program officials from the following locations:

- U.S. Navy Headquarters, Washington, D.C.;
- U.S. Marine Headquarters, Arlington, Virginia;
- Office of the Chief of Naval Operations, Washington, D.C.;
- U.S. Special Operations Command, Tampa, Florida;
- V-22 Program Office, Crystal City, Virginia; and
- Naval Air Warfare Station, Patuxent River, Maryland.

Finally, we visited contractor facilities at Boeing Defense and Space Group-Helicopters Division, Philadelphia, Pennsylvania, and Bell Helicopter Textron, Fort Worth, Texas.

We performed our review from March 1996 through June 1997 in accordance with generally accepted government auditing standards.

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We are sending copies of this report to the Secretary of the Navy; the Secretary of the Air Force; the Commandant of the Marine Corps; and the Director, Office of Management and Budget. We will also make copies available to others on request.

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Please contact me at (202) 512-4841 if you or your staff have any questions concerning this report. Major contributors to this report were Steven F. Kuhta, Assistant Director; Samuel N. Cox, Evaluator-in-Charge; and Brian Mullins, Senior Evaluator.

A handwritten signature in black ink, reading "Louis J. Rodrigues". The signature is written in a cursive style with a large, looping initial "L".

Louis J. Rodrigues  
Director, Defense Acquisitions Issues

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List of Congressional Committees

The Honorable Strom Thurmond  
Chairman

The Honorable Carl Levin  
Ranking Minority Member  
Committee on Armed Services  
United States Senate

The Honorable Ted Stevens  
Chairman  
The Honorable Daniel K. Inouye  
Ranking Minority Member  
Subcommittee on Defense  
Committee on Appropriations  
United States Senate

The Honorable Floyd Spence  
Chairman  
The Honorable Ronald V. Dellums  
Ranking Minority Member  
Committee on National Security  
House of Representatives

The Honorable C. W. Bill Young  
Chairman  
The Honorable John P. Murtha  
Ranking Minority Member  
Subcommittee on National Security  
Committee on Appropriations  
House of Representatives



# V-22 Procurement Schedule and Cost Estimate

(Then-year dollars in millions)

Fiscal year	Units	Program office estimate		Selected acquisition report	
		Program flyaway cost	Unit flyaway cost	Program flyaway cost	Unit flyaway cost
1997	5	\$579.9	\$116.0	\$561.3	\$112.3
1998	5	494.8	99.0	480.7	96.1
1999	7	597.6	85.4	579.0	82.7
2000	8	611.0	76.4	591.3	73.9
2001	16	1,179.5	73.7	1,139.9	71.2
2002	24	1,617.2	67.4	1,559.3	65.0
2003	31	1,810.1	58.4	1,738.4	56.1
2004	31	1,720.4	55.5	1,652.5	53.3
2005	31	1,671.8	53.9	1,606.8	51.8
2006	31	1,642.7	53.0	1,578.8	50.9
2007	31	1,629.6	52.6	1,566.2	50.5
2008	29	1,499.9	51.7	1,442.0	49.7
2009	24	1,239.2	51.6	1,192.0	49.7
2010	26	1,356.5	52.2	1,304.9	50.2
2011	26	1,371.2	52.7	1,318.9	50.7
2012	27	1,440.7	53.4	1,385.9	51.3
2013	27	1,463.4	54.2	1,407.6	52.1
2014	27	1,478.9	54.8	1,422.4	52.7
2015	27	1,500.2	55.6	1,443.2	53.5
2016	30	1,690.3	56.3	1,626.2	54.2
2017	30	1,715.0	57.2	1,649.9	55.0
2018	30	1,778.4	59.3	1,710.8	57.0
<b>Total</b>	<b>523</b>	<b>\$30,088.3</b>	<b>\$57.5</b>	<b>\$28,958.0</b>	<b>\$55.4</b>

# Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



ACQUISITION AND  
TECHNOLOGY

## OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON  
WASHINGTON, DC 20301-3000

27 AUG 1997

Mr. Louis Rodrigues  
Director, Defense Acquisitions Issues  
National Security and International Affairs Division  
U.S. General Accounting Office  
Washington, D.C. 20548

Dear Mr. Rodrigues:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "NAVY AVIATION: V-22 Cost and Capability to Meet Multi-Service Requirements Yet to Be Determined," dated July 24, 1997 (GAO Code 707156), OSD Case 1422. The DoD partially concurs with the draft report.

The GAO recommends that the Secretary of Defense provide in the President's Budget request an explanation of how it plans to 1) introduce more realistic testing earlier into the V-22 program schedule, and 2) achieve the production efficiencies desired by the Congress.

The Department considers test results, production efficiencies, and other factors in developing its budget. Submission of additional explanatory materials is not considered necessary. The Defense Acquisition Board (DAB) Low-Rate Initial Production (LRIP) review in April 1997 determined that the V-22 test program was adequate and properly sequenced. In addition, the Quadrennial Defense Review (QDR) resulted in an accelerated production profile that addresses many of the production efficiencies desired by Congress. The FY 1999 President's budget will reflect these decisions.

The GAO report also included some factual errors regarding cost estimates. Contractor estimates do not include other government costs which must be included in budget summaries and the Selected Acquisition Report (SAR). It appears that the GAO report compared the Program Office budget estimate, which was expressed in then-year dollars, with the December 1996 SAR, which was expressed in constant year dollars. There is no difference in the Program Office estimate and the SAR—only differences attributed to a comparison of then-year and constant year dollars.

The GAO also cited potential V-22 operational deficiencies which require discussion. The refueling probe visibility and propotor downwash issues will continue to be assessed during developmental and operational testing in accordance with the approved Test and Evaluation Master Plan. Corrective actions will be developed and implemented for deficiencies found during testing.



See comment 1.

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See comments 2 & 3.

The V-22 Operational Requirements Document (ORD) validated by the Joint Requirements Oversight Council in June 1995 has neither a specific airspeed requirement for carrying external loads nor a requirement for installing a laser warning receiver. Also, the Terrain Following/Terrain Avoidance radar is a CV-22-unique requirement (and one of its key features). The April DAB approved specific exit criteria to assure adequate testing is conducted prior to advance procurement for CV-22 initial production in FY 2000.

See comment 4.

The defensive weapon (gun) and a ground collision avoidance and warning system are unfunded ORD threshold requirements for the baseline MV-22 variant. The Department will address these requirements in its Program Objective Memorandum/budget deliberations.

The DoD appreciates the opportunity to comment on the draft report.



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The following are GAO's comments on the Department of Defense's (DOD) letter dated August 27, 1997.

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## GAO Comments

1. We recalculated the cost data obtained from the V-22 Selected Acquisition Report, using DOD inflation indices, to reflect then-year dollars for comparison to program office budget estimates. The recalculated cost data are reflected in the final report.

2. We agree that the Operational Requirements Document (ORD) validated by the Joint Requirements Oversight Council in June 1995 does not specify an airspeed requirement for carrying external loads. However, the V-22 program was justified on the basis that it would overcome the shortcomings of the Marine Corps' current medium-lift helicopters. In that regard, the ORD is specific in identifying inadequate payload, range, speed and survivability in the current medium-lift force that severely limit the Marine Corps' ability to accomplish the assault support missions in current and future threat environments.

We also agree that the ORD does not identify the specific equipment that the V-22 must have to protect the aircraft and crew from laser threats. However, the ORD does require that the aircraft be designed for operations in a hostile environment with features that increase aircraft, crew, and passenger survivability. Specifically, it requires that consideration be given to protecting crew and electro-optical sensors from low- to medium-powered lasers. While the MV-22 will be equipped with an AN/AVR-2A laser-warning receiver, the CV-22 will not be so equipped. Instead, the aircraft will be produced with available space and wiring for installation of laser protection capabilities.

3. We note that the approved CV-22 exit criteria is as follows:

- For lot 1 advanced procurement funding, flight testing of the first of two CV-22 flight test aircraft must have started.
- For lot 1 full funding and advanced procurement for lot 2, flight testing with the second CV-22 aircraft must have started and the terrain following/terrain avoidance testing must have started using the first CV-22 aircraft.

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We question the value of “flight test started” as sufficient criteria for making an informed decision to proceed with production of the CV-22 model aircraft.

4. This comment is consistent with the discussion in the report.